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1.	Your reference	06 OCT 1997
2.	Patent application number *(The Patent Office will fill in this part)*	**9721155.1**
3.	Full name, address and postcode of the or of each applicant *(underline all surnames)*	JOHN PETER GAHAN 4, CADLOCKS HILL, HALSTEAD, KENT, TN14 7DU
	Patents ADP number *(if you know it)*	07299373001
	If the applicant is a corporate body, give the country/state of its incorporation	
4.	Title of the invention	ROTARY TWO-STROKE ENGINE
5.	Name of your agent *(if you have one)* "Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*	JOHN PETER GAHAN 4, CADLOCKS HILL, HALSTEAD, KENT, TN14 7DU
	Patents ADP number *(if you know it)*	07299373001
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11. I/We request the grant of a patent on the basis of this application.

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12. Name and daytime telephone number of person to contact in the United Kingdom JOHN PETER GAHAN 01959534402

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ROTARY TWO-STROKE ENGINE

FIELD OF THE INVENTION

This invention relates to motors of the rotary type including a cylinder block rotatably mounted within an engine housing, containing a plurality of cylinders varying in volume, in sequence, in response to the relative movement between the piston members and the cylinders. The motor may be in the form of a heat engine operating on internal or external combustion, a hydraulic or pneumatic motor or a pneumatic compressor.

BACKGROUND ART

There have been proposed numerous constructions of motors wherein the relative movement between the piston members and the housing is rotational and employing the two stroke cycle of operation. However, the strength of the crankshaft, the side thrust loads on the pistons and the port timing have all been compromised. In addition, it is necessary to address and keep to a minimum the pollution created by the engine.

Three particularly relevant patents which illustrate the nature of the motor or engine under consideration are U.S. Patent No. 2,683,422 (A. Z. Richards, Jnr.), U.S. Patent No. 3,200,797 (Dillenberg) and U.S. Patent No. 3,517,651 (Graybill). The entire disclosure of these three U.S. patents is incorporated herein by cross reference.

DISCLOSURE OF THE INVENTION

It is therefore an object of this invention to provide a two stroke motor of the rotary piston type which addresses one or more of the above mentioned problems.

According to the present invention there is provided a motor of the rotary type including a cylinder block rotatably mounted within an engine housing, a crankshaft journalled for rotation in said engine housing, piston members rotatably supported on said crankshaft for rotary motion in said cylinder block as said crankshaft and said cylinder

block rotate, and a plurality of cylinders arranged to define chambers between said cylinders and said piston members that vary in volume, in sequence, in response to the relative movement between said piston members and said cylinders.

The engine housing is formed by peripheral spacers and opposed end casings; with the cylinder block supported on the crankcase for rotational movement and the crankcase supported on two main bearings, one on each of the respective end casings.

The piston may have a rod portion extending through a gas seal and an oil seal to the crankshaft bearing. The crankshaft is connected to the crankcase by epicyclic gears giving a 2:1 reduction. Two complete revolutions of the crankshaft cause one complete revolution of the cylinder block. This positive gearing between the crankshaft and the crankcase reduces the side thrust between the piston and the cylinder during rotation under operating conditions, resulting in a reduced rate of wear and reduced friction.

By providing running clearance between the connecting rod, at the bearing end and the crankcase guides, torsional stress on the crankshaft is reduced.

Variable timing of the induction and/or transfer phases permits the engine to perform at peak efficiency over a wide range of engine speeds. The variable flow cooling system permits the engine to operate at its ideal temperature under varying conditions.

Passing pure air through the cylinder after combustion, returning any unused fuel/air mixture to the inlet tract and closing the exhaust passage before the fresh fuel/air mixture enters the cylinder reduces pollution of the atmosphere to the minimum.

The present invention is applicable to internal combustion engines wherein the cylinders are supported in the housing for rotation in a direction normal to the plane of the crankshaft and the pistons are connected to the crankshaft so that each piston may move relative thereto in a direction normal to the direction of rotation of the eccentric bearing.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will be more readily understood with reference to the following description of an internal combustion engine incorporating the present invention, as illustrated in the accompanying drawings, wherein :-

Fig. 1 is a perspective, part section view of the two stroke rotary engine.

Fig. 2 is a cross section view through the engine of Fig. 1.

Fig. 3 is a vertical section view through the engine of Fig. 1

Fig. 4 is a horizontal section view through the engine of Fig. 1

Fig. 5 is a cross section view of the epicyclic gears

Fig. 6 is a perspective view of one of the crankcase halves

Fig. 7 is a view of one end casing with tracts

Fig. 8 is a view of the casing-side seal rings and the exhaust plate

Fig. 9 is a view of the cylinder-side seal rings

Fig. 10 is a view of the inlet and transfer timing rings with locating bars

Fig. 11 is a side section view through one cylnder and ports of the engine and illustrating a first position of operation

Fig. 12 is a view as for Fig. 11 and illustrating a second position of operation

Fig. 13 is a view as for Fig. 11 and illustrating a third position of operation

Fig. 14 is a view as for Fig. 11 and illustrating a fourth position of operation

Fig. 15 is a view as for Fig. 11 and illustrating a fith position of operation

Fig. 16 is an electrical circuit to control the position of one timing ring

Fig. 17 is a view of one of the timing ring control mechanisms

Fig. 18 is an electrical circuit to control the position of the air vents

Fig. 19 is a view of the variable air vent control mechanism

MODES FOR CARRYING OUT THE INVENTION

With reference to Figs.1 to 5 inclusive, an engine 1 comprises ideally an engine housing 3 comprised of two end casings 95A and 95B, held rigidly together by engine bolts 100 and spacers 101 and supporting two main bearings 13A and 13B, within which rotates a crankshaft 7 having crankpins 8A and 8B, and upon which rotates a crankcase 6 comprised of halves 6A and 6B which are attatched to the cylinder block 2 comprising two pairs of opposed cylinders 4 located radially at right-angles to each other. Pistons 22 and connecting rods 18 are mounted for sliding, reciprocating motion within the cylinder block 2 and coact so as to cause rotation of the crankshaft 7 via the crankpins 8A and 8B with respect to the engine housing 3. The crankshaft 7 is mounted securely in the engine housing 3 by the main bearings 13A and 13B allowing the crankshaft 7 to rotate but to remain at all times in the same relative position with respect to the common centre of the cylinder axes. The epicyclic gears 5 of ratio 2:1, comprising the crankshaft gear 9, two idler gears 11A and 11B and the crankcase gear 10, place the crankcase 6 in positive rotary engagement with the crankshaft 7.

The engine 1 may be air and/or liquid cooled.

With particular reference to Fig. 2, the cylinders have been drawn sectioned for explanatory purposes, even though the horizontal cylinders are behind the vertical cylinders, as illustrated in Fig. 1. Induction is accomplished by the underside of the piston 22 drawing gas into the induction chamber 30 through the inlet port 32 when it is in line with the inlet tract 76. As the cylinder block 2 rotates in a clockwise direction and the piston 22 reaches T.D.C. the inlet port 32 is closed by the blank part of the inlet timing ring 69 pressing against the inlet orifice 38 in the cylinder-side inlet seal ring 37.

As the cylinder block 2 continues to rotate, the gas under the piston 22 is forced

through the transfer port 33 into the inner transfer tract 79, then through the transfer joining tract 85 to the outer transfer tract 82. As the outer ports 34A and 34B pass the outer transfer tracts 82A and 82B, the gas enters the outer cylinder 26.

In the power chamber 29 of the outer cylinder 26, the gas is compressed and as the piston 22 approaches T.D.C. the spark plug 116 is timed to ignite the mixture. The power stroke continues until the exhaust port 35 is uncovered by the piston 22, allowing the exhaust gas to escape instantaneously under its own pressure through the exhaust seal ring orifice 50 which is now in line with the exhaust plate orifice 104. The outer ports 34A and 34B are then opened to atmosphere via the air tracts 86A and 86B to purge the outer cylinder 26 of any residual exhaust gas. The air tracts 86A and 86B then close and the outer transfer tracts 82A and 82B open after the exhaust seal ring orifice 50 has been closed, allowing the fresh charge to enter the outer cylinder 26 but preventing any of the fuel/air mixture from escaping down the exhaust pipe 111. The gas is then compressed by the piston 22 in preparation for the next power stroke.

The piston 22 may be cooled internally by the air ports 36A and 36B in the cylinder 4 allowing cooling air to pass through the ancillary chamber 31.

The compressed fuel/air mixture is ignited within the outer cylinder 26 by means of a spark plug 116 which is in rotary, conductive communication with a high tension lead 118 via an ignition strip 119. Pressure springs 121 maintain electrical contact between the top of the spark plug 116 and the ignition strip 119 which is insulated from the housing 117 by an insulating pad 120. The assembly is retained by a retaining plate 122. The ignition strip 119 is chamfered on its leading edge so that when the cylinders 4 expand, the top of the spark plug 116 pushes the ignition strip 119 against the springs 121 into the cavity in the housing 117 without jamming. One high tension lead 118 for each ignition

strip 119 is required due to the staggered cylinders 4, requiring them to be independently sprung. The length of the ignition strip 119 allows for the required ignition advance. The ignition timing may be controlled from a separate shaft, suitably geared to the engine 1 or from pick-ups located on the cylinder block 2.

With particular reference to Figs. 3 and 4, the driving gear 14 may be bolted to the crankcase 6A and held by a keyway (not shown). The engine oil may drain through the crankcase 6 and/or the cylinder block 2 into the oil drain tracts 93A and 93B and then into the end casings 95A and 95B to return to the sump via internal oilways or external pipes (not shown). The drive-side main bearing 13A may be supported by a separate plate 98 attatched to the end casing 95A by the engine bolts 100 and spacers 99 allowing clearance for the driving gear 14 and the timing ring control mechanisms 128IR and 128TR. By extending the crankshaft 7 to protrude beyond the end casings 95A and 95B, modules of the engine 1 may be connected together.

Between the casing-side seal rings and the end casings, around each tract, is a synthetic rubber "O" ring, settled part into a groove in the end casing and pressing onto the back side of the seal ring. Pressure upon assembly ensures that the seal ring is pressed firmly against its mating surface but not too much to actually close the gap around the synthetic rubber "O" ring. This allows the sealing function to be accomplished by the teflon coated surface of the seal ring rubbing against its mating surface. The dowel pins ensure that the seal ring is always in line with its relative tracts. Variations due to expansion upon warming up and during the course of operation are accommodated by the synthetic rubber "O" rings behind the seal rings being under compression.

This sealing system may also be used on the cylinder ports whereby it is possible to have both seal rings floating and rubbing against each other. Each seal ring is a full

circle ensuring contact at all times. Both seal rings may be teflon coated on their mating surfaces and may be assisted by spring pressure.

Fuel and air communicate within the engine 1 via air chokes 149A and 149B, reed valves 150A and 150B, inlet tracts 76A and 76B, inner transfer tracts 79A and 79B, outer transfer tracts 82A and 82B, transfer joining tracts 85A and 85B, air tracts 86A and 86B, pressure release tracts 89A and 89B, inlet port 32, transfer port 33 and outer ports 34A and 34B. Fuel is combined with air via fuel injectors 148A and 148B.

Sealing mechanisms, as illustrated, include connecting rod oil seal 16 and gas seal 17, crankcase seals 96A and 96B, drive case seal 23, oil drain tract seals 94A and 94B, inlet tract seals 77A and 77B, inner transfer tract seals 80A and 80B, outer transfer tract seals 83A and 83B, air tract seals 87A and 87B and pressure release tract seals 90A and 90B. Also included are casing-side inlet seal rings 53A and 53B, casing-side transfer seal rings 57A and 57B, casing-side outer seal rings 61A and 61B, cylinder-side inlet seal rings 37A and 37B, cylinder-side transfer seal rings 41A and 41B, cylinder-side outer seal rings 45A and 45B, inlet timing rings 69A and 69B, transfer timing rings 73A and 73B, exhaust seal ring 49, exhaust plate 103 and exhaust pipe rings 112.

Combustion gases enter the cylinder 4 via cylinder-side inlet seal ring orifices 38A and 38B, cylinder-side transfer seal ring orifices 42A and 42B, cylinder-side outer seal ring orifices 46A and 46B, casing-side inlet seal ring orifices 54A and 54B, casing-side transfer seal ring inner transfer orifices 58A and 58B, casing-side outer seal ring air orifices 62A and 62B, pressure release orifices 64A and 64B, and outer transfer orifices 63A and 63B, inlet timing ring orifices 70A and 70B and transfer timing ring orifices 74A and 74B.

Exhaust gases pass out through exhaust port 35 exhaust manifold 52, exhaust seal ring orifice 50 and exhaust plate orifice 104 into the exhaust pipe 111.

The relative position of the sealing components is maintained by cylinder-side seal ring counter-sunk screws and casing-side seal ring dowel holes 56, 60 and 68 which receive locating dowels 55, 59 and 67 therewithin.

The timing rings 69 and 73 are permitted to rotate some degrees by the elongated holes 72 in the end casings 95A and 95B, allowing movement of the retaining bars 71, being held by the timing ring control plates 128IR and 128TR.

Note that gas passages in the end casings 95A and 95B are referred to as "tracts", in the cylinder 4 as "ports" and in the seal rings as "orifices".

An "induction chamber" 30 is defined in the space between the base of the piston 22 and the cylinder block 2. An "ancillary chamber" 31 is defined in the space around the piston 22 between the larger diameter piston base and the smaller diameter outer cylinder 26. A "power chamber" 29 is defined in the space between the crown of the piston 22 and the cylinder head 27.

Features of forms of the described arrangements include:-

1. The timing of the inlet port, transfer port, outer ports and the exhaust port is controlled by the position of the cylinder block and not by the piston itself.

2. Because the transferred gas enters the outer cylinder by another cylinder port, an outer transfer tract is required. This may be joined to the inner transfer tract by a groove machined in the end casing.

3. Unused fuel/air mixture is returned to the incoming charge by the pressure release tract being joined to the inlet tract via a groove machined in the end casing.

4. The big-end of the connecting rod runs in guides in the crankcase reducing the torsional loads on the crankshaft.

5. The crankshaft is geared to the crankcase but unlike Dillenberg, the gears are not

direct. The introduction of the two idler gears allows the crankshaft gear and the crankcase gear to be larger in diameter while still maintaining the correct direction of rotation. This allows the crankshaft to be made larger in diameter, otherwise the strength of the crankshaft would be compromised due to the gearing.

6. The swept volume of the induction chamber may be made equal to the swept volume of the power chamber by increasing the bore of the inner cylinder to compensate for the volume of the connecting rod. A larger capacity induction chamber would mean that the engine is effectively supercharged.

7. The ancillary chamber is open to atmosphere, reducing pumping losses and cooling the piston and cylinder internally, thus requiring less cooling fin area.

8. The primary compression of the induced fuel/air mixture is increased due to the base of the piston meeting flush with the cylinder block at B.D.C.

9. Variations in running clearance due to expansion do not affect the sealing of the engine because the seal rings are permitted to slide in their mountings.

Fig. 6 illustrates one half of the crankcase 6A with the crankcase gear 10. The crankcase 6 is comprised of two halves 6A and 6B bolted together to locate the inner oil seals 16 and the outer gas seals 17 around the connecting rods 18. The oil seals 16 and gas seals 17 are positioned by recesses 15 machined in the cylinder block 2.

Fig. 7 illustrates the respective positions of the exhaust plate clearance hole 105, pressure release tract 89, inner transfer tract 79, outer transfer tract 82, transfer joining tract 85, inlet tract 76, air tract 86, dowel locating holes 56, 60 and 68, timing ring slots 72, exhaust pipe attachment holes 114 exhaust plate dowel locating holes 108 and engine bolt holes 102 in one end casing 95. Around each tract is a groove to locate the synthetic rubber "O" rings. The grooves which do not enclose a tract are used to

locate another synthetic rubber "O" ring which acts as a spacing rubber 65. This equalizes the pressure on the seal ring around the whole of its surface area.

Fig. 8 illustrates the respective positions of the casing-side inlet 53 transfer 57 and outer 61 teflon coated seal rings and the ceramic coated exhaust plate 103.

Section AA in Fig. 8 is a cross-section of the exhaust plate 103 taken through the exhaust plate orifice 104. The exhaust plate 103 may be ceramic coated on its rubbing surface and positioned away from the end casing 95 to fit over the exhaust pipe 111 being sealed by the exhaust pipe rings 112 which seal in the same way as piston rings. The exhaust pipe 111 may be attatched to the end casing 95 by bolts 113 and heat resistant washers 115. There should be enough clearance to allow the free passage of cooling air between the exhaust plate 103 and the end casing 95. The contact area should be kept to a minimum to reduce heat transfer and distortion.

Section BB in Fig. 8 is a cross-section of the casing-side inlet 53 transfer 57 and outer 61 seal rings taken through the inlet 54 inner transfer 58 and outer transfer 63 orifices showing the synthetic rubber "O" rings and their locating grooves, the transfer joining tract 85 and the elongated holes 72 for the timing ring retaining bars 71.

Section CC in Fig. 8 is across-section of the casing-side inlet seal ring 53 and the outer seal ring 61 taken through the dowel locating holes 56 and 68 with locating dowels 55 and 67. It also shows the spacing rubber 65 of the casing-side transfer seal ring 57.

Section DD in Fig. 8 is a cross-section of the exhaust plate 103 taken through the locating dowel 107, showing the heat resistant sleeves 109 and the pressure springs 106.

Fig. 9 illustrates the respective positions of the teflon coated cylinder-side inlet seal rings 37,transfer seal rings 41 and outer seal rings 45 showing the counter-sunk locating holes 40 and the ceramic coated exhaust seal ring 49. If preferred, the cylinder-side seal

rings 37, 41 and 45 may be made in one piece with the ports being sealed by synthetic rubber "O" rings and located by dowels.

Section EE in Fig. 9 is a cross-section of the ceramic coated exhaust seal ring 49 taken through the exhaust seal ring orifice 50 showing the bolt holes 24 to attatch the ring 49 to the cylinder block 2 and the guides 51 to allow for expansion of the ring 49. The exhaust seal ring orifices 50 line up with the exhaust manifolds 52 described with reference to Fig. 2. The exhaust seal ring 49 may incorporate the ring gear for the starter motor.

The exhaust manifolds 52 may be positioned on the trailing edge of the cylinder 4 or the leading edge for cooling air and may be bolted to the outer cylinder 26 and bolted or welded to the exhaust seal ring 49. The exhaust manifold 52 may be "T" shaped so that there would be an exhaust pipe 111 on each side of the engine 1, as also there may be two fuel injectors 145A and 145B. By making the exhaust manifold "L" shaped, it would be possible to have one fuel injector 145 and one exhaust pipe 111 on the same side, for fitting into a car for example, with the clutch on the other side. Or as above, but with one fuel injector 145 and one exhaust pipe 111 on opposite sides of the engine 1.

Fig. 10 illustrates the rotatable timing rings 69 and 73 showing that the orifices 70 and 74 are shorter than the casing-side seal ring orifices 54 and 58. This allows for movement of the timing rings 69 and 73 without compromising gas flow.

Section FF in Fig. 10 is a cross-section of the teflon coated timing rings 69 and 73 taken through the transfer timing ring retaining bar 71 and the inlet timing ring orifice 70.

With particular reference to Figs. 11 to 15 inclusive, progressive operational phases of the engine 1 will be described.

Fig. 11 illustrates the piston 22 on the power stroke. The exhaust pipe 111 is already open to the exhaust manifold 52 by the exhaust plate orifice 104 aligning with the

exhaust seal ring orifice 50. This is done before the piston 22 uncovers the exhaust port 35 so that the minimum restriction is offered to the exhausting gas. The underside of the piston 22 is compressing the fresh charge into the inner transfer tract 79.

Fig. 12 illustrates the piston 22 approaching B.D.C. after the high pressure exhaust gas in the outer cylinder 26 has been released through the exhaust pipe 111. The outer port 34 is open to atmosphere, via the choke control 149, by the casing-side outer seal ring air orifice 62 aligning with the cylinder-side outer seal ring orifice 46, allowing fresh cold air to pass across the crown of the piston 22, having been induced into the outer cylinder 26 by the low pressure created by the exhausting gas. This purges the outer cylinder of any remaining exhaust gas. Although the outer port 34 is opened after the exhaust port 35 is opened, the transfer of fresh gas is prevented by the casing-side outer seal ring 61 until both the air orifice 62 and the exhaust orifice 50 are closed.

Fig. 13 illustrates the piston 22 at B.D.C. where the exhaust seal ring orifice 50, the cylinder-side outer seal ring orifice 46, the cylinder-side transfer seal ring orifice 42 and the cylinder-side inlet seal ring orifice 38 are all closed.

Fig. 14 illustrates the piston 22 commencing the compression stroke. The outer ports 34A and 34B are open to the outer transfer tracts 82A and 82B by the cylinder-side outer seal ring orifices 46A and 46B aligning with the casing-side outer seal ring outer transfer orifice 63. The transferred gas connot escape to pollute the exhaust because the exhaust seal ring orifice 50 is closed by the ceramic coated exhaust plate 103. The underside of the piston 22 commences the induction stroke.

With particular reference to Fig. 15, at low engine speeds there is enough time for all the compressed, transferred gas to enter the outer cylinder 26 before the piston 22 closes the outer port 34. But at higher engine speeds this critical time is reduced. Thus,

there are pressure release orifices 64A and 64B in the casing-side outer seal rings 61A and 61B which open after the outer transfer tracts 82A and 82B and outer ports 34A and 34B have been closed. This allows any residual fresh charge in the outer ports 34A and 34B to be returned via the pressure release tracts 89A and 89B to the low pressure inlet tracts 76A and 76B. Thus, the next time that the piston 22 is in the exhaust phase, no residual fresh charge is exhausted when the air tracts 86A and 86B are opened.

With reference to Figs. 16 and 17, the electrical circuit to control the position of the timing rings 69 and 73 shows that alternatively they may be controlled electronically by a frequency counter and transistorized circuitry.

The r.p.m. counter needle is insulated from the driving pin. The point of the needle makes contact with strips associated with the r.p.m. control points. The other end of the needle contacts a positive strip through an electrical resistance. These strips are insulated from the r.p.m. counter body 145. The r.p.m. control points may or may not be evenly spaced, as also the grooves 127R in the timing ring control plate 128R, to locate the "RLS" locking solenoid, may or may not be evenly spaced, depending upon the power characteristics required from the engine.

The movement of one inlet timing ring 69A will be described. The other inlet timing ring 69B may be positioned by a similar electrical circuit and control mechanism. The transfer timing rings 73A and 73B may be similarly controlled with different degrees of movement, if desired.

For example, consider that the engine was turning at 3,500 r.p.m. and is now turning at 5,500 r.p.m. The r.p.m. counter needle applies a +ve potential to the associated contact strip, operating "RW" relay. "RW1" contact prepares for the operation of "R" relay. "RW2" contact operates the "RLS" locking solenoid. As the tongue of the "RLS"

locking solenoid is about to clear the groove 127IR in the inlet timing ring control plate 128IR, the "RLS" contacts operate. "RLS2" contact operates "R" relay through "RW1" contact being already operated. "RLS1" contact is associated with "A" relay.

"R2" contact energizes the retard valves "RA" and "RB", permitting oil pressure to be applied to one end of the plunger rod 136IR whilst releasing pressure from the other end. The oil, under pressure from the oil pump, enters one control cylinder 135IR and pushes the plunger rod 136IR against the inlet timing ring control plate 128IR, with its attached sprung contact 131IR, causing it to move and remove the -ve potential from the contact 134IR on the control strip 133IR, releasing "RW" relay. "RW2" contact releases the "RLS" locking solenoid to rest on the edge of the inlet timing ring control plate 128IR. The "RLS" contacts remain operated until spring pressure causes the tongue of the "RLS" locking solenoid to enter next the groove 127IR in the inlet timing ring control plate 128IR when it becomes aligned. This holds the plate 128IR rigidly in position and returns the "RLS" contacts to their normal position. At this point the contact 134IR on the control strip 133IR is positioned so that a -ve potential is applied via the sprung contact 131IR. "RLS2" contact releases "R" relay. "R2" contact releases the retard valves "RA" and "RB", removing oil pressure from the plunger rod 136IR.

Increasing the speed of the engine 1 to 8,000 r.p.m. would repeat a similar action via "RV" relay. Decreasing the speed of the engine 1 back to 3,500 r.p.m. would cause the inlet timing ring control plate 128IR to move in the opposite direction via "AW" relay and the advance valves "AA" and "AB". The movement of the timing ring control plate 128R directly positions the associated timing ring via the retaining bars 71.

With reference to Figs. 18 and 19, the electrical circuit to control the position of the air vents 123A and 123B of the engine 1 may be similar to the electrical circuit to

control the position of the timing rings 69 and 73. The movement of the air vents 123A and 123B may be controlled electronically by transistorized circuitry.

The temperature gauge needle is insulated from the driving pin. The point of the needle makes contact with strips associated with the temperature control points. The other end of the needle contacts a positive strip through an electrical resistance. These strips are insulated from the temperature gauge body 146. The temperature control points may or may not be evenly spaced, as also the grooves 127A in the air vent control plate 128A, to locate the "ALS" locking solenoid, may or may not be evenly spaced, depending upon the temperature characteristics required from the engine 1.

For example, consider that the engine 1 was running at 110 C and is now running at 120 C. The temperature gauge needle applies a +ve potential to the associated contact strip, operating "OW" relay. "OW1" contact prepares for the operation of "O" relay. "OW2" contact operates the "ALS" locking solenoid. As the tongue of the "ALS" locking solenoid is about to clear the groove 127A in the air vent control plate 128A, the "ALS" contacts operate. "ALS2" contact operates "O" relay through "OW1" contact being already operated. "ALS1" contact is associated with "C" relay.

"O2" contact energizes the opening valves "OA" and "OB", permitting oil pressure to be applied to one end of the plunger rod 136A whilst releasing pressure from the other end. The oil, under pressure from the oil pump, enters one control cylinder 135O and pushes the plunger rod 136A against the air vent control plate 128A, with its attatched sprung contact 131A, causing it to move and remove the -ve potential from the contact 134A on the control strip 133A, releasing "OW" relay. "OW2" contact releases the "ALS" locking solenoid to rest on the edge of the air vent control plate 128A. The "ALS" contacts remain operated until spring pressure causes the tongue of the "ALS" locking

solenoid to enter the next groove 127A in the air vent control plate 128A when it becomes aligned. This holds the plate 128A rigidly in position and returns the "ALS" contacts to their normal position. At this point the contact 134A on the control strip 133A is positioned so that a -ve potential is applied via the sprung contact 131A. "ALS2" contact releases "O" relay. "O2" contact releases the opening valves "OA" and "OB", removing oil pressure from the plunger rod 136A.

A temperature increase to 130 C would repeat a similar action via "OV" relay. A temperature decrease back to 110 C would cause the air vent control plate 128A to move in the opposite direction via "CW" relay and the closing valves "CA" and "CB". Movement of the air vent control plate 128A directly positions the air vents 123A and 123B via the control cables 125A and 125B and the tensioning springs 124A and 124B.

Features of forms of the described arrangements include:-

1. On the power stroke the piston uncovers the exhaust port, allowing the high pressure gas to escape. Then, even though the piston uncovers the outer port, no fuel/air mixture enters the outer cylinder because of the side seals.

2. Before B.D.C. it is possible to open the outer port to atmosphere via the choke control allowing fresh cold air to pass across the crown of the piston and purging the outer cylinder of any remaining exhaust gas.

3. There is no pollution of the exhaust gas by the fresh incoming charge because the exhaust seal ring orifice is blocked by a heat resistant ceramic seal (e.g. Silicon Nitride) before the compressed fresh gas enters the outer cylinder.

4. Fuel wastage is kept to a minimum because any fuel/air mixture not passed into the outer cylinder is returned to the inlet tract via the pressure release tract.

5. The timing of the induction and/or transfer phases of the engine is variable

depending upon the speed of rotation of the engine.

6. Engine temperature may be controlled under running conditions by varying the opening of the air vents in the engine housing. By monitoring the air and/or oil temperature, the air circulation may be varied automatically by electronic control.

7. The electrical air vent control circuit may be similar to the electrical timing ring control circuit, as also may be the mechanical control mechanism.

8. The ceramic coated exhaust plate is slidably mounted in the end casing and has a larger exposed surface area on the exhaust pipe side than on the cylinder side so that the exhaust pressure seals it against the ceramic coated exhaust seal ring.

The above describes only some embodiments of the present invention and modifications obvious to those skilled in the art can be made thereto without departing from the scope and spirit of the present invention.

It is to be appreciated that port timing may be changed as also may the length and positioning of the tracts (with relative changes to the seal ring orifices) in accordance with experimental data obtained in relation to parameters such as gas velocity, port shape, the torque of the engine and the desired speed limit.

By positioning the combustion chamber to the side of the cylinders, the engine may be adapted for diesel or steam operation. Use as a steam engine would require port relocation and all seal rings to be ceramic coated.

INDUSTRIAL APPLICABILITY

The invention may be applied to internal combustion engines, heat engines operating on internal or external combustion, hydraulic or pneumatic motors, pneumatic compressors or steam engines of the rotary type.

CLAIMS

1. A motor of the rotary type including a cylinder block rotatably mounted within an engine housing, a crankshaft journalled for rotation within said engine housing, piston members rotatably supported on said crankshaft for rotary motion within said cylinder block as said crankshaft and said cylinder block rotate, and a plurality of cylinders arranged to define chambers between said cylinders and said piston members that vary in volume, in sequence, in response to the relative movement between said piston members and said cylinders.

2. The motor of claim 1 wherein said cylinder block is rotatably geared to said crankshaft by epicyclic gears of ratio 2:1.

3. The motor of claim 2 wherein said epicyclic gears comprise two idler gears.

4. The motor of claim 3 wherein timing of entry of combustion gases into said chambers is controlled by side entry tracts located in the end casings for communication with ports in said cylinders.

5. The motor of claim 4 wherein said ports of said cylinders and said side entry tracts are sealed by intimate contact between rotating seal rings.

6. The motor of claim 5 wherein said chambers are open to atmosphere after combustion via air chokes, allowing fresh cold air to pass across the crown of individual ones of said piston members, thereby purging said chamber of any remaining exhaust gas.

7. The motor of claim 6 wherein the amount of said cold air is synchronized by said air chokes with the amount of fuel/air mixture consumed by said motor.

8. The motor of claim 7 wherein the induction and/or transfer phases are automatically variable to coincide with the change of speed of said motor.

9. The motor of claim 8 wherein the cooling system is automatically variable to

ensure that the temperature of said motor remains within set limits during operation.

10. The motor of claim 9 wherein the electrical circuit to control said temperature is similar to the electrical circuit to control said induction and/or transfer phases.

11. The motor of claim 10 wherein the exhaust system is sealed by the pressure of the exhaust gas itself.

12. The motor of claim 11 wherein the movement of the connecting rod at the bearing end is controlled by rigid guides in the crankcase.

13. The motor of claim 12 wherein individual ones of said piston members is cooled internally via air ports in the cylinder wall.

14. The motor of claim 13 wherein the primary compression of the induced fuel/air mixture is infinite due to the solid base of said piston member.

15. The motor of claim 14 wherein any unused portion of said induced fuel/air mixture is returned to the incoming charge.

16. The motor of claim 15 wherein expansion of said motor upon reaching operating temperature does not affect the sealing of said motor due to the compressable synthetic rubber "O" rings and/or the locating dowels.

ABSTRACT

A motor of the rotary type including a cylinder block rotatably mounted within an engine housing, a crankshaft journalled for rotation in said housing, geared at 2:1 ratio to said cylinder block, piston members rotatably supported on said crankshaft for rotary motion in said cylinder block as said crankshaft and said cylinder block rotate, and a plurality of cylinders arranged to define chambers between said cylinders and said piston members that vary in volume, in sequence, in response to the relative movement between said piston members and said cylinders.

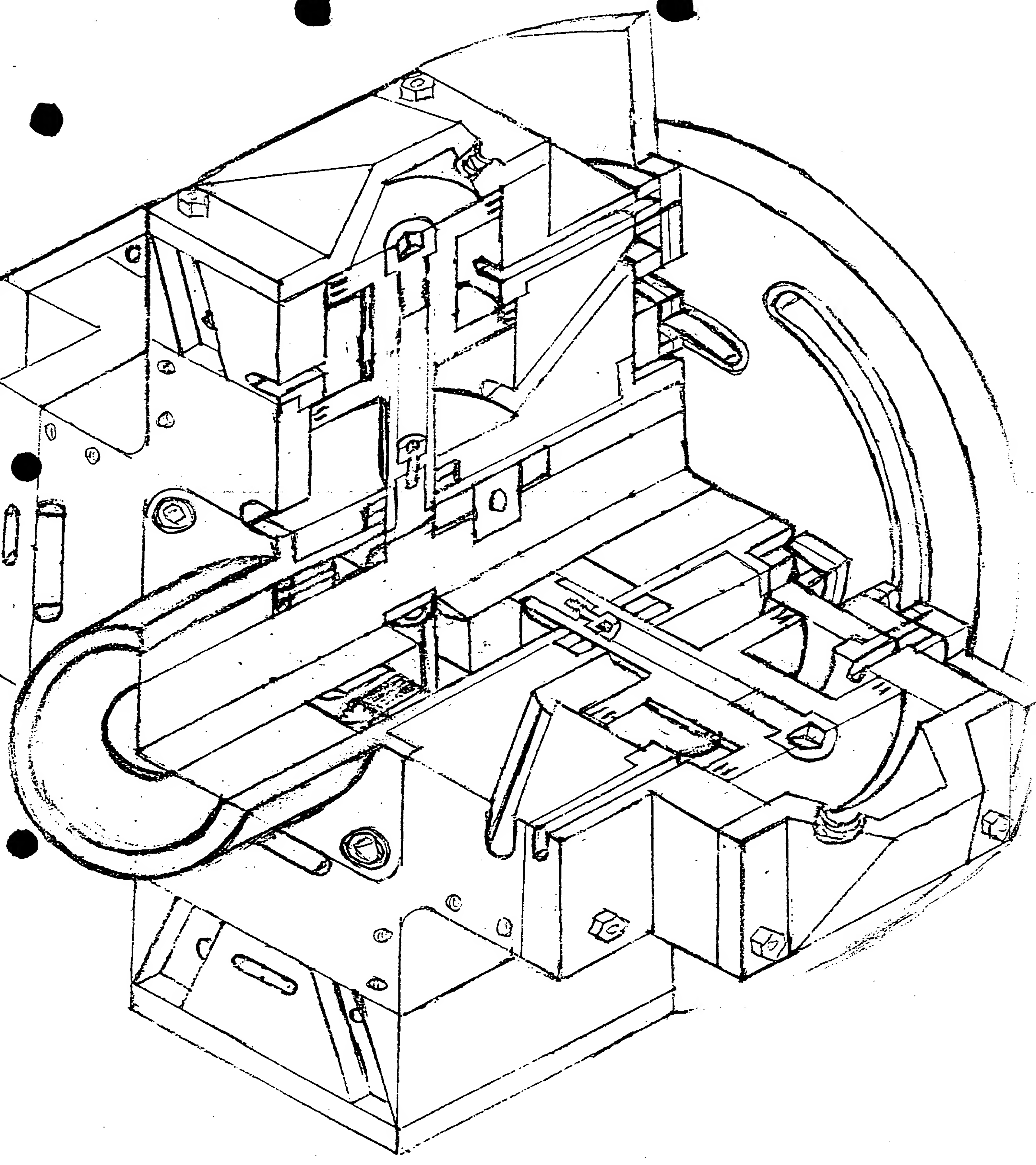
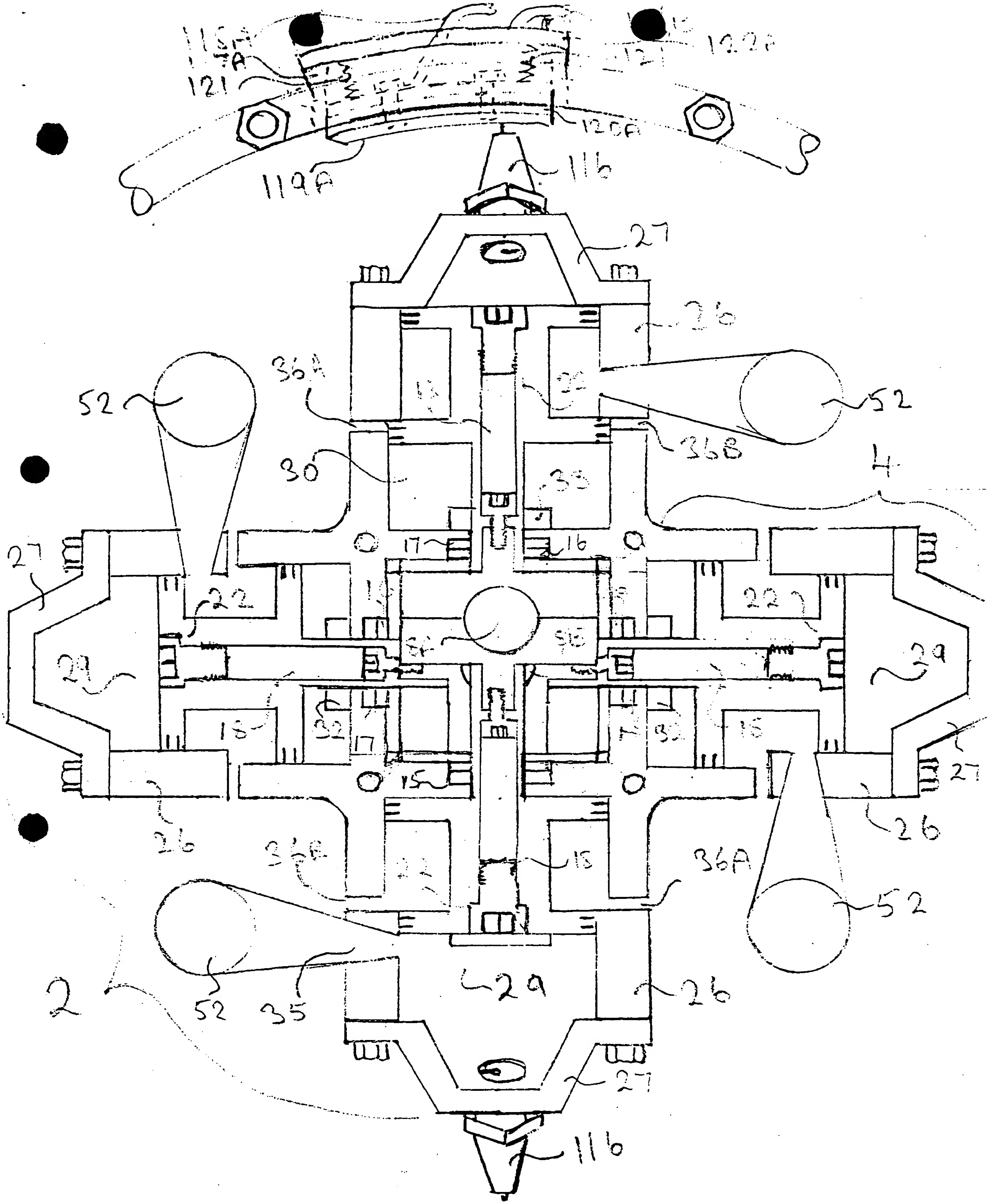


Fig. 1



115A
115
121A
121
122A
120A
119A
116
27
26
36A
52
36B
30
33
4
17
16
22
29
18
32
15
26
35
2

FIG. 2

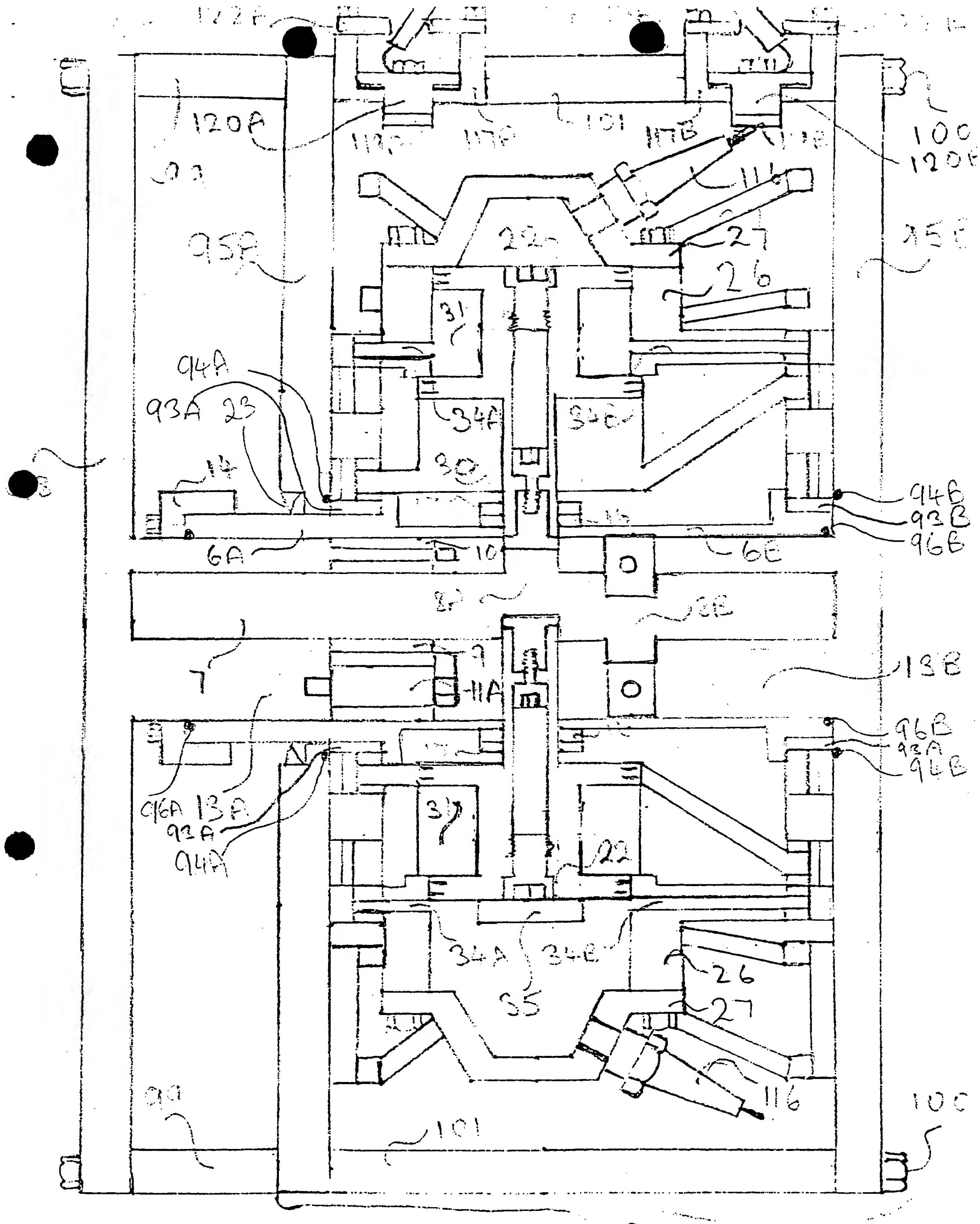

120A
120B
117A
117B
101
100
116
95A
95B
22
27
26
31
94A
93A
23
34A
34B
30
14
6A
6B
10
94B
93B
96B
8A
8B
7
13B
9
11A
96A
13A
22
35
99

FIG. 3

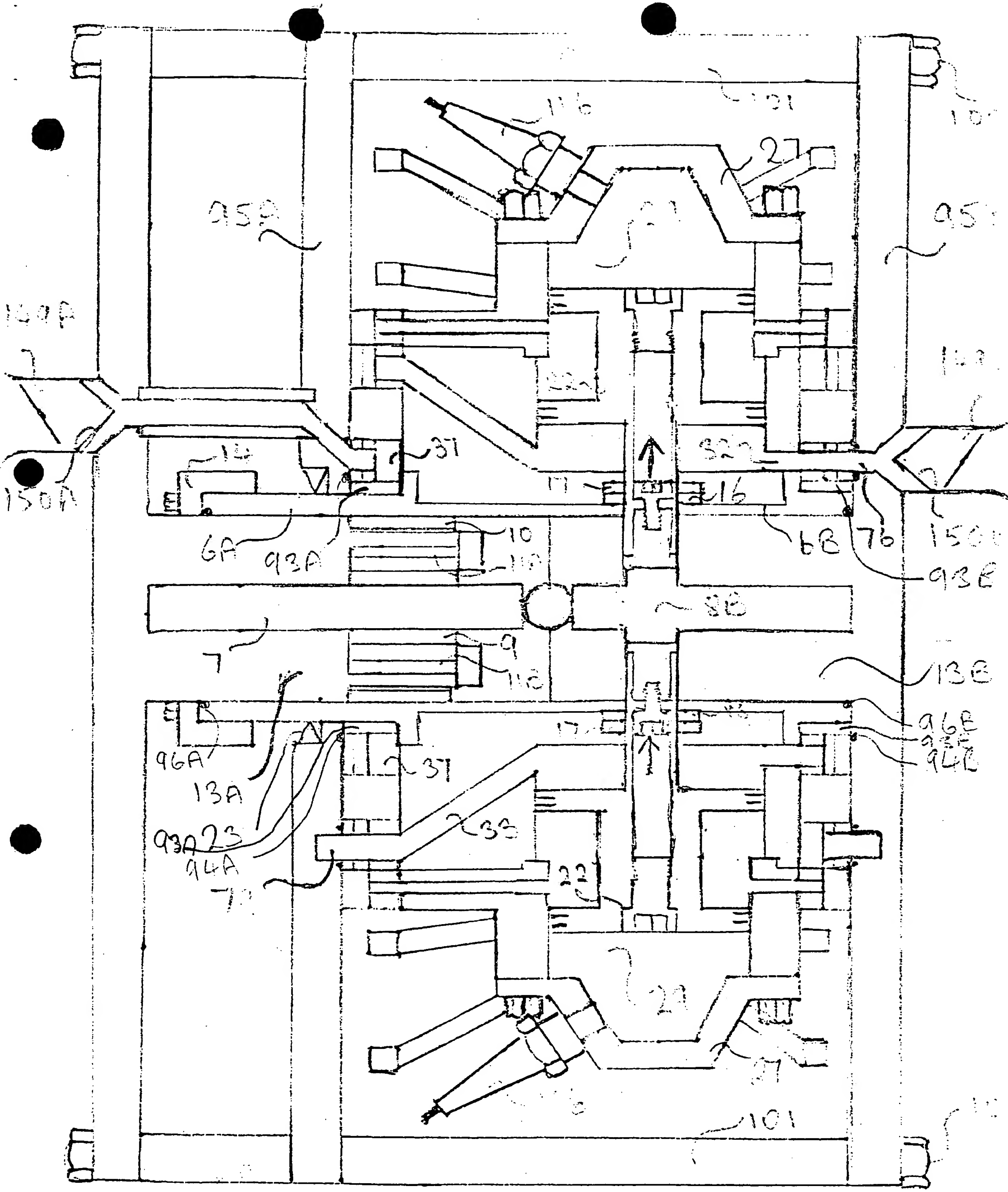

95A
95B
149A
150A
14
37
6A
93A
10
11A
17
16
6B
7B
93B
8B
7
9
11B
13B
96B
96A
13A
93A
23
94A
94B
33
22
24
27
101

FIG. 4

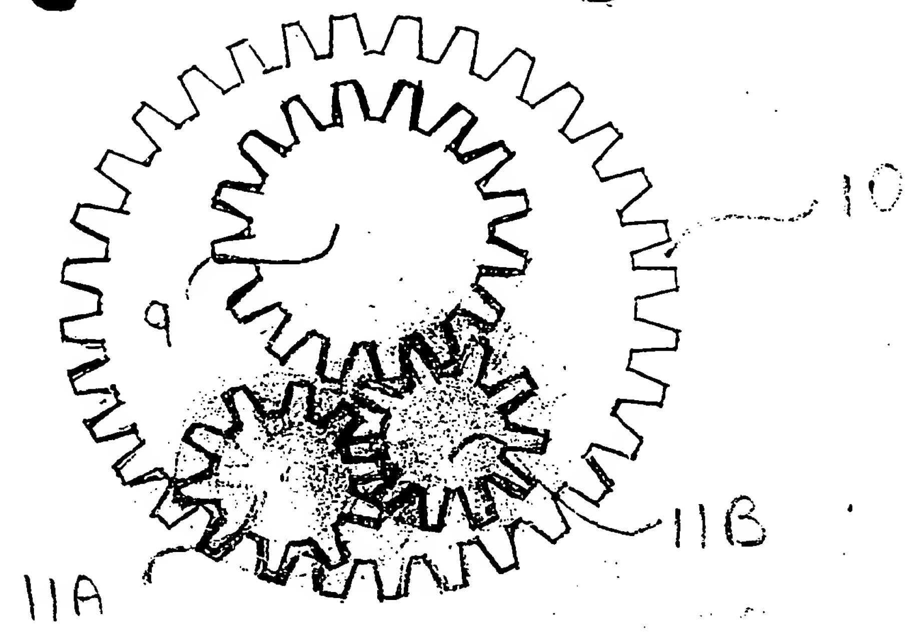


Fig. 5

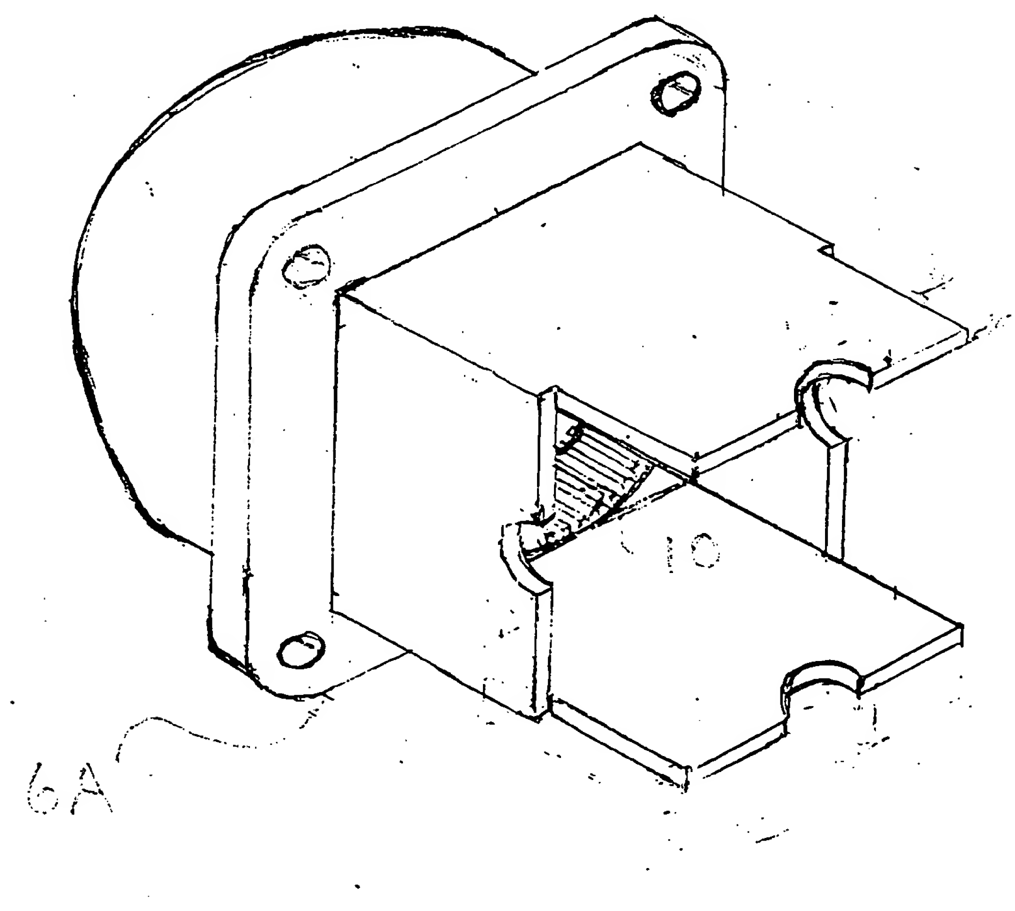
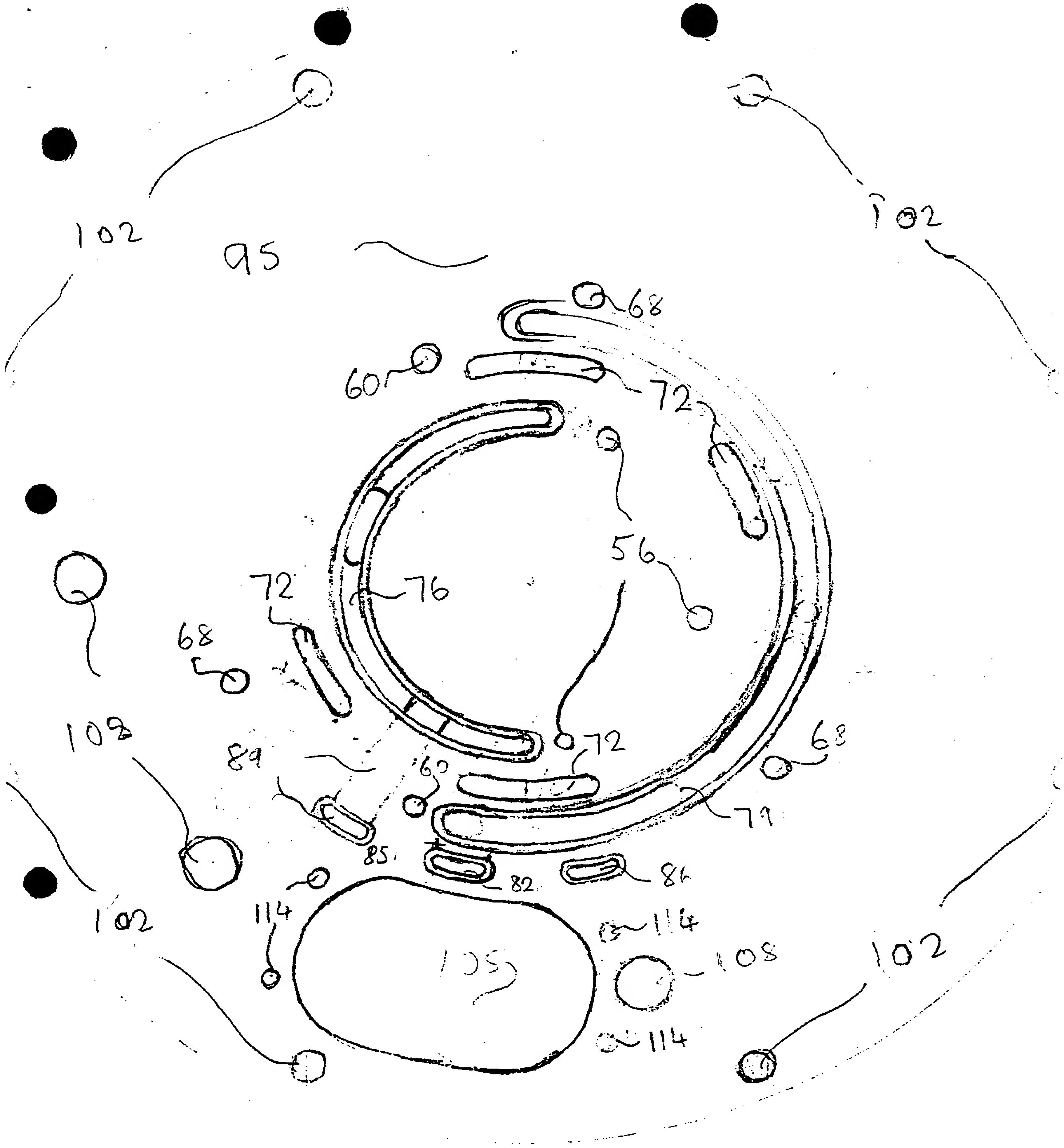


Fig. 6



102
95
102
68
60
72
56
76
72
68
108
89
72
60
68
79
85
82
86
114
102
114
105
108
102
114

FIG. 7

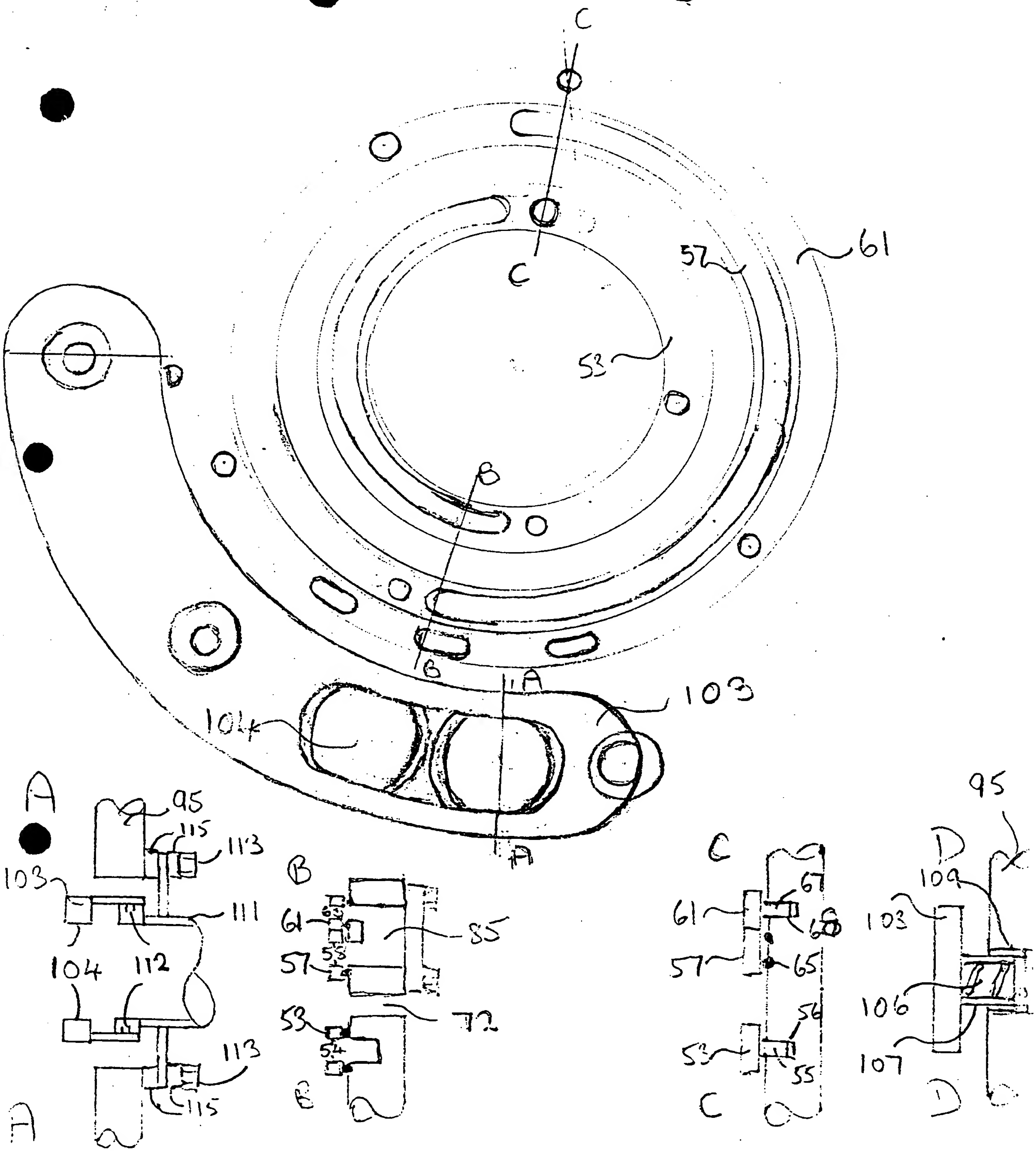
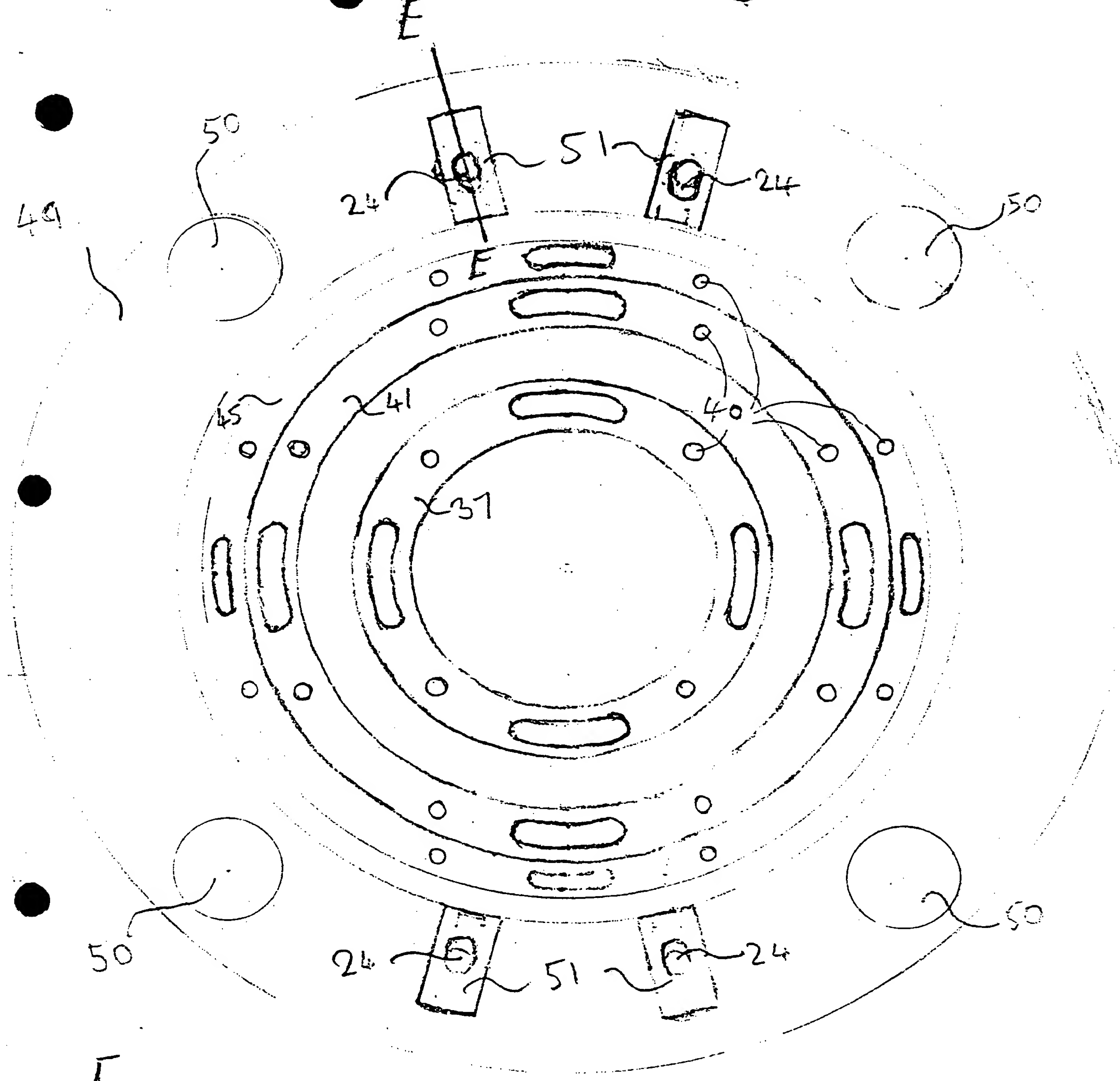

C
C
57
61
53
B
B
A
103
104
A
A
95
115
113
103
111
104
112
113
115
A
B
61
85
57
53
72
54
B
C
61
67
57
65
53
56
55
C
D
95
109
103
106
107
D

FIG. 8



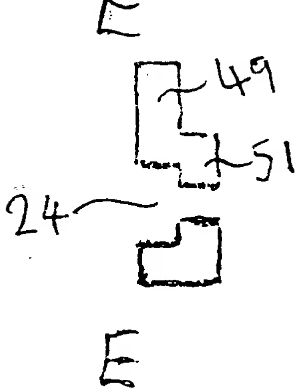


FIG. 9

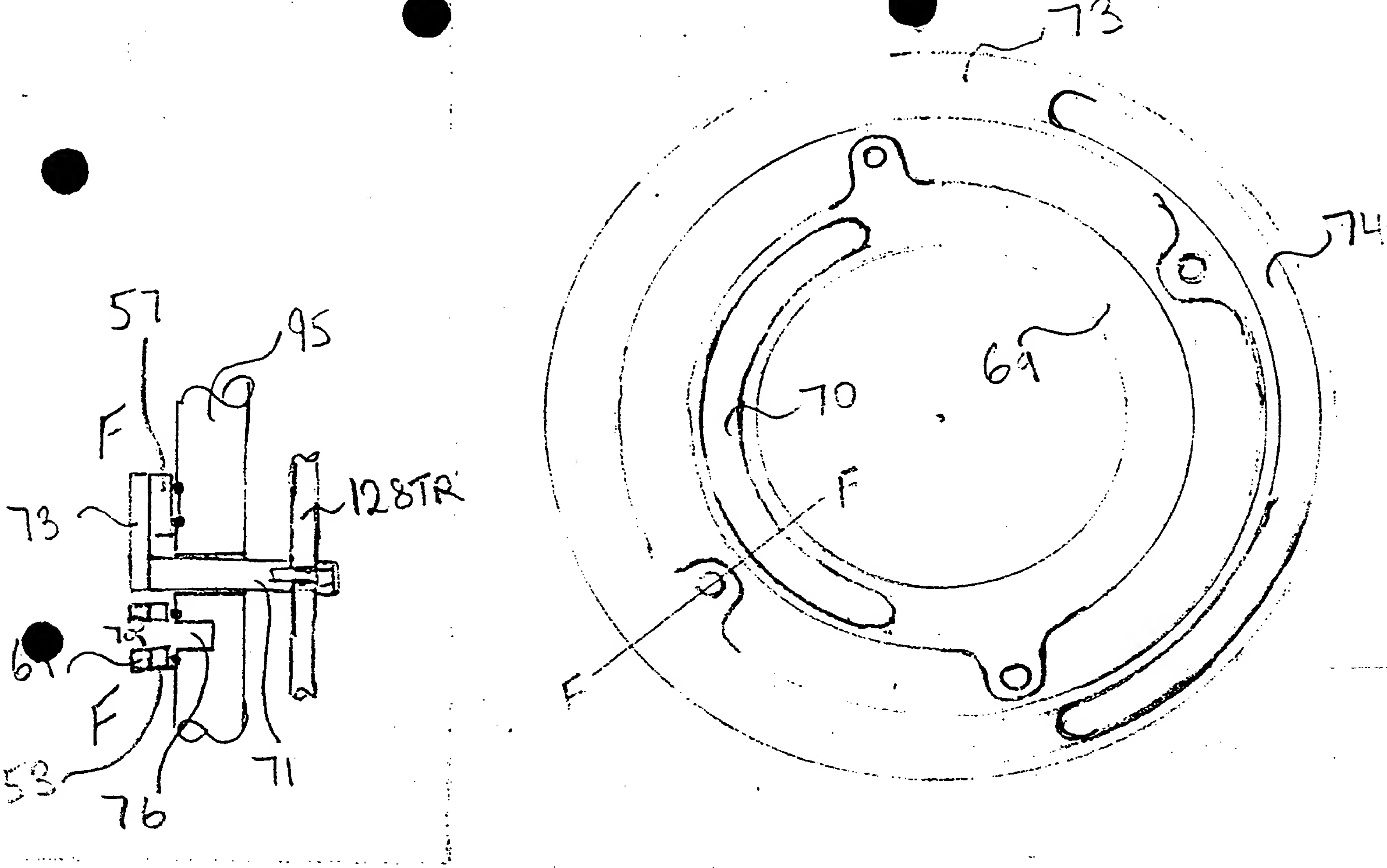

57
95
F
73
128TR
78
69
F
53
76
71
73
74
69
70
F
F

FIG. 10

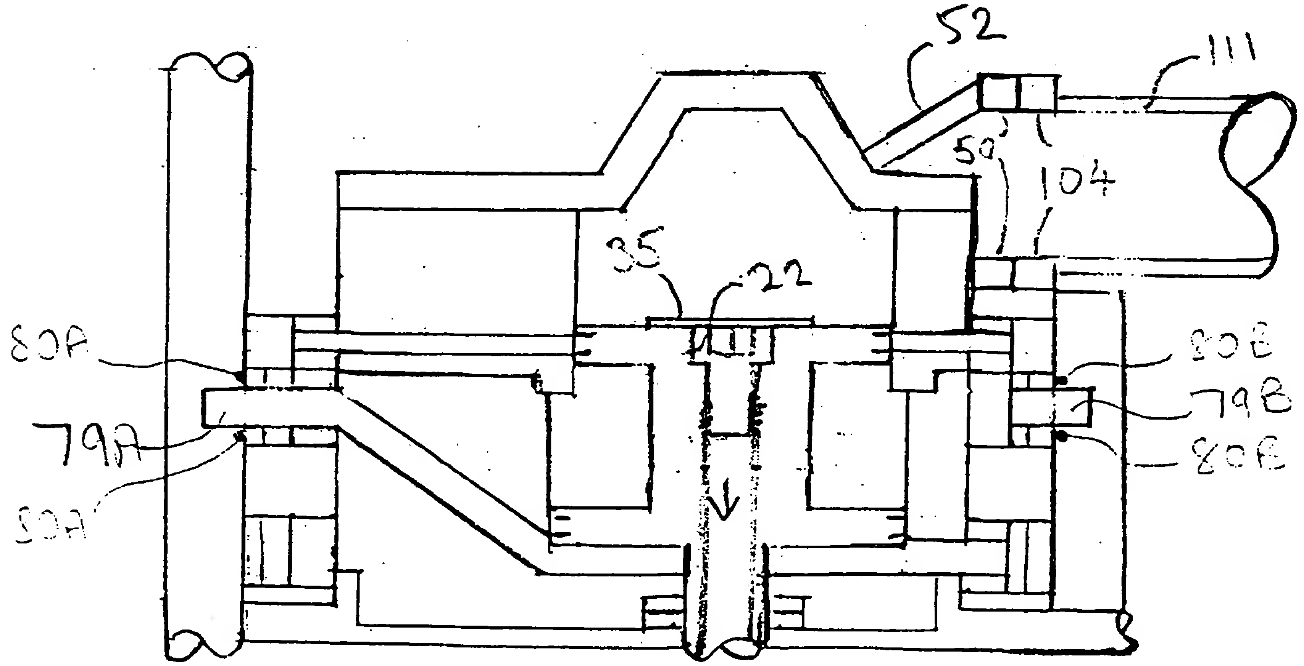

52
111
50
104
35
22
80A
80B
79A
79B
80B
80A

FIG. 11

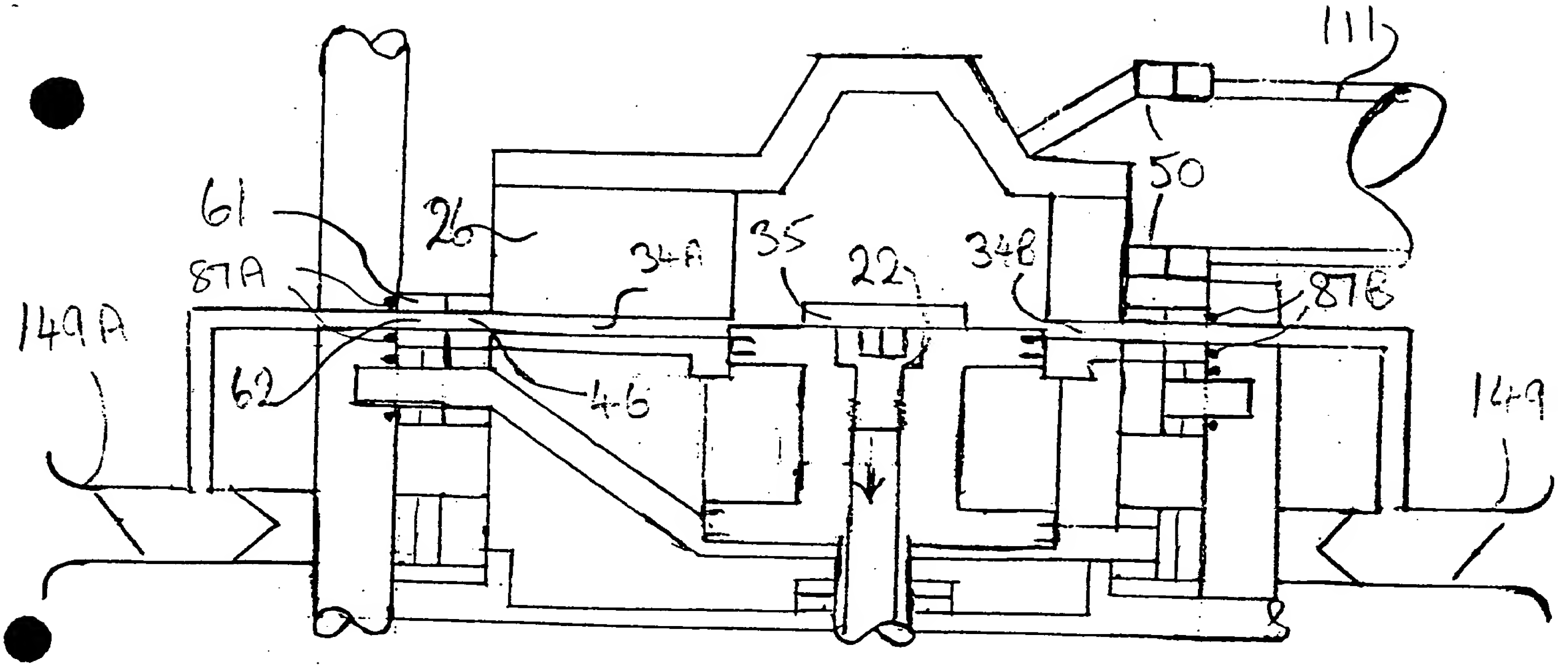


FIG. 12

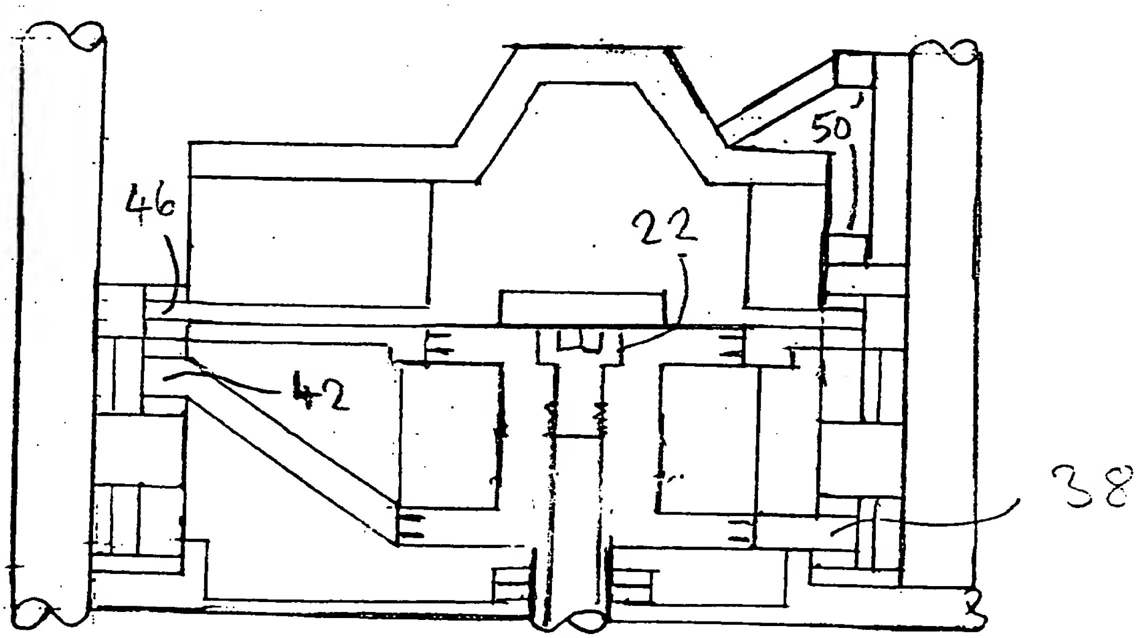


FIG. 13

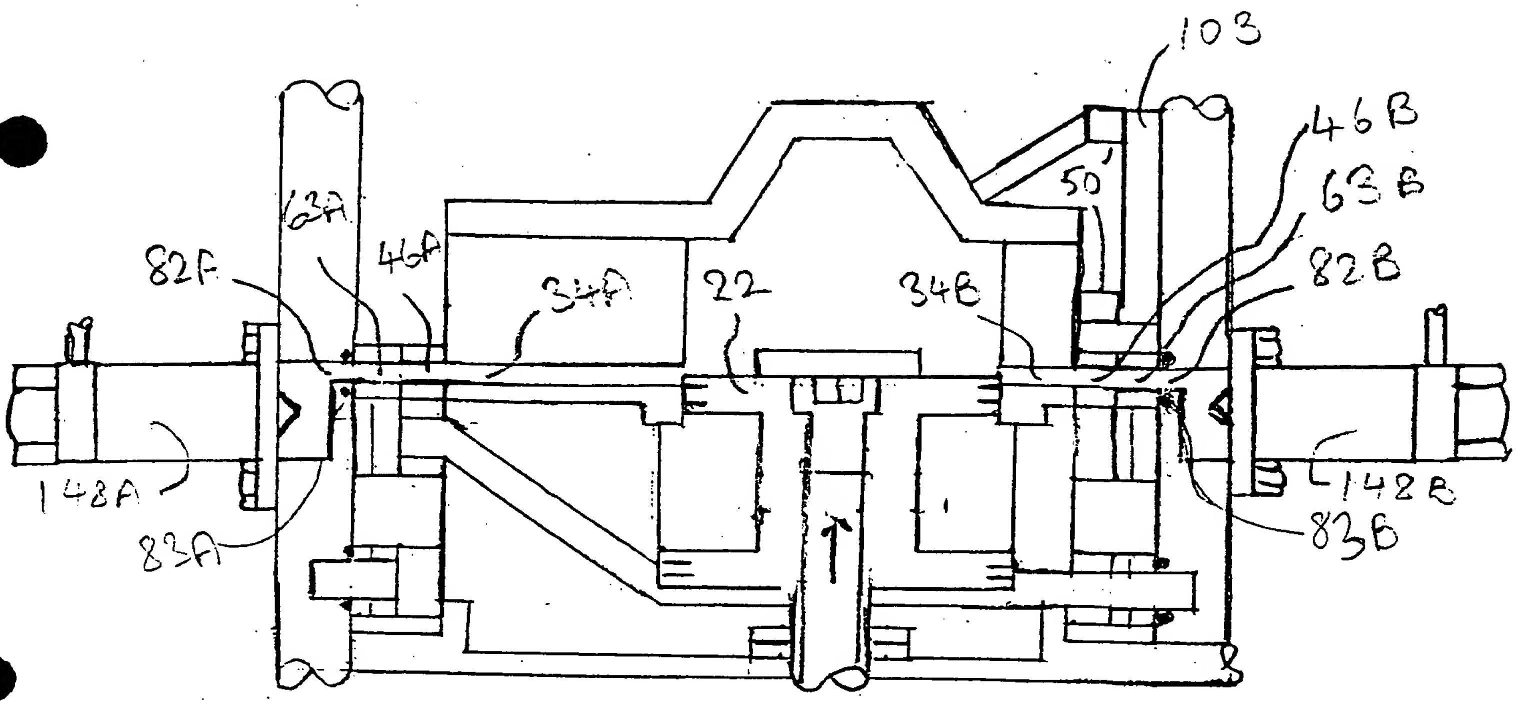

103
46B
50'
63B
63A
82A
46A
34A
22
34B
82B
148A
83A
148B
83B

FIG. 14

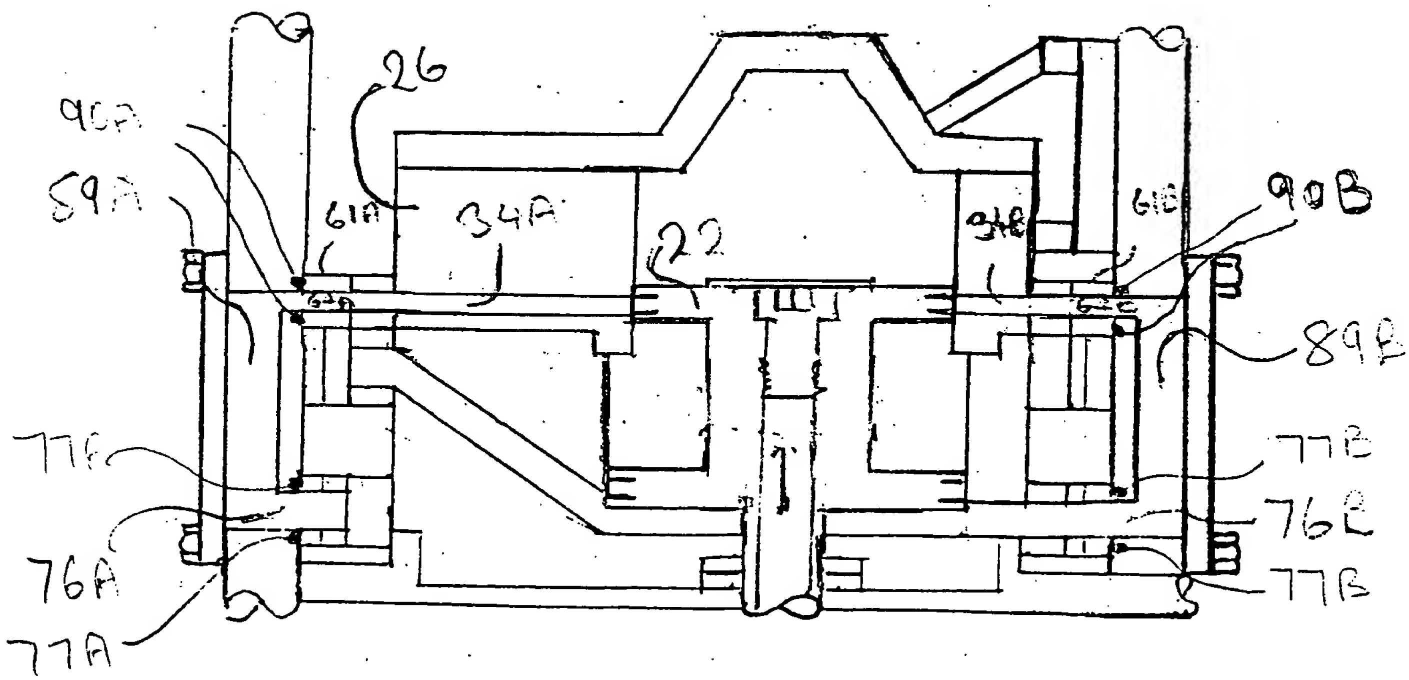
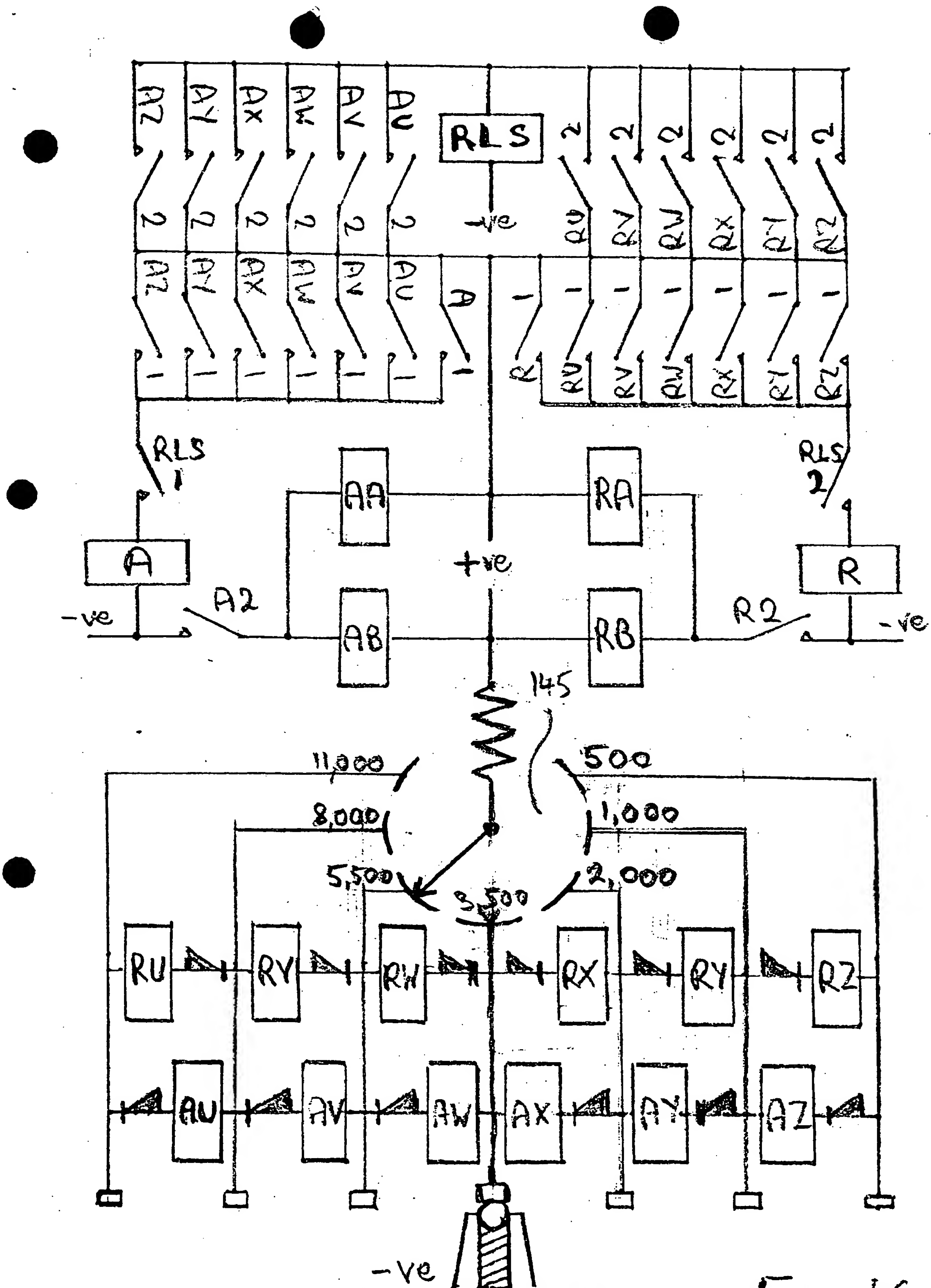

26
90A
59A
61A
34A
22
34B
61B
90B
89B
77A
76A
77A
77B
76B
77B

FIG. 15



RLS
-ve
RLS 1
RLS 2
A
R
AA
RA
AB
RB
+ve
A2
R2
145
11,000
8,000
5,500
3,500
2,000
1,000
500
RU
RV
RW
RX
RY
RZ
AU
AV
AW
AX
AY
AZ

FIG. 16

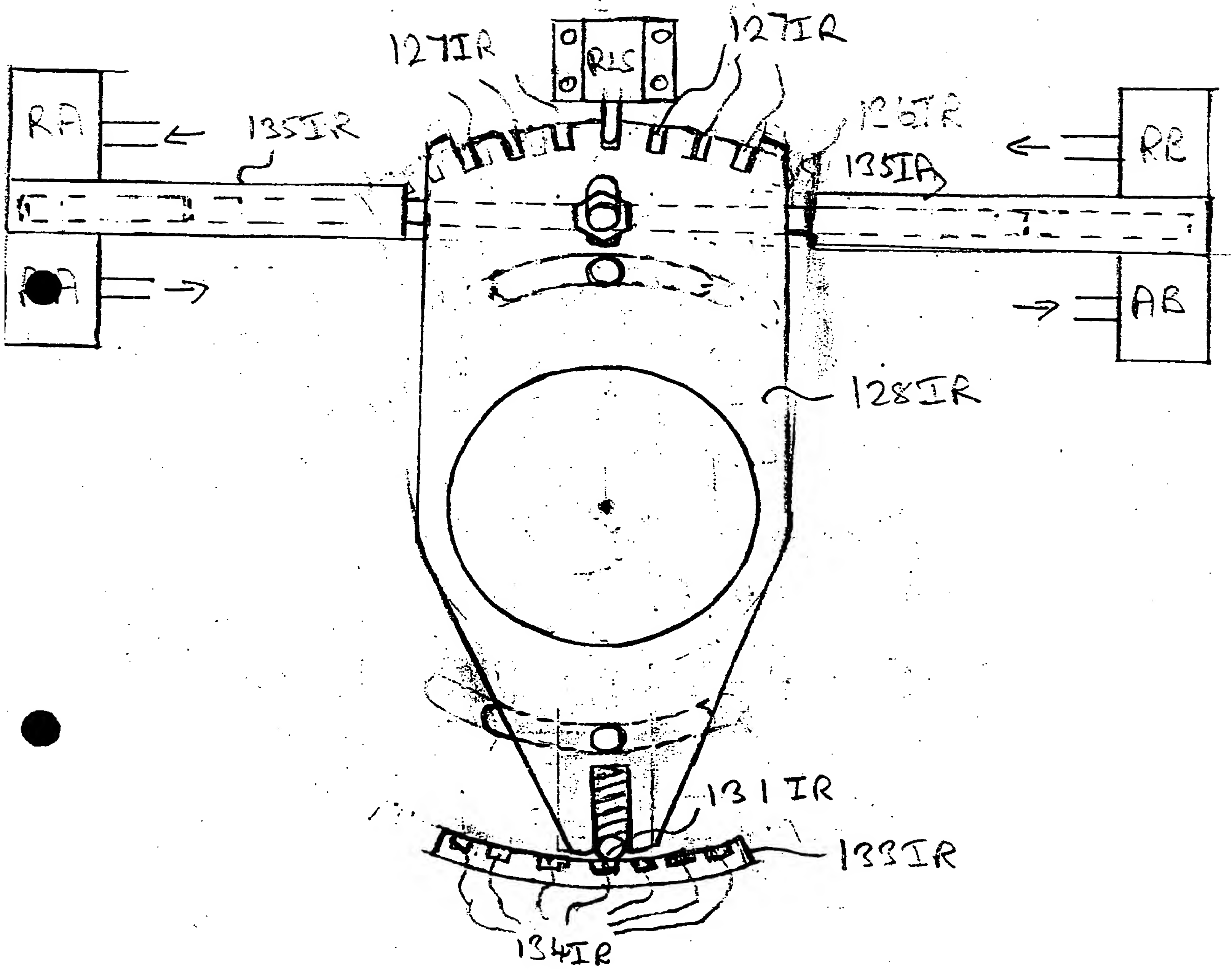

127IR
RLS
127IR
RA
135IR
126IR
RB
135IA
RA
AB
128IR
131IR
133IR
134IR

FIG. 17

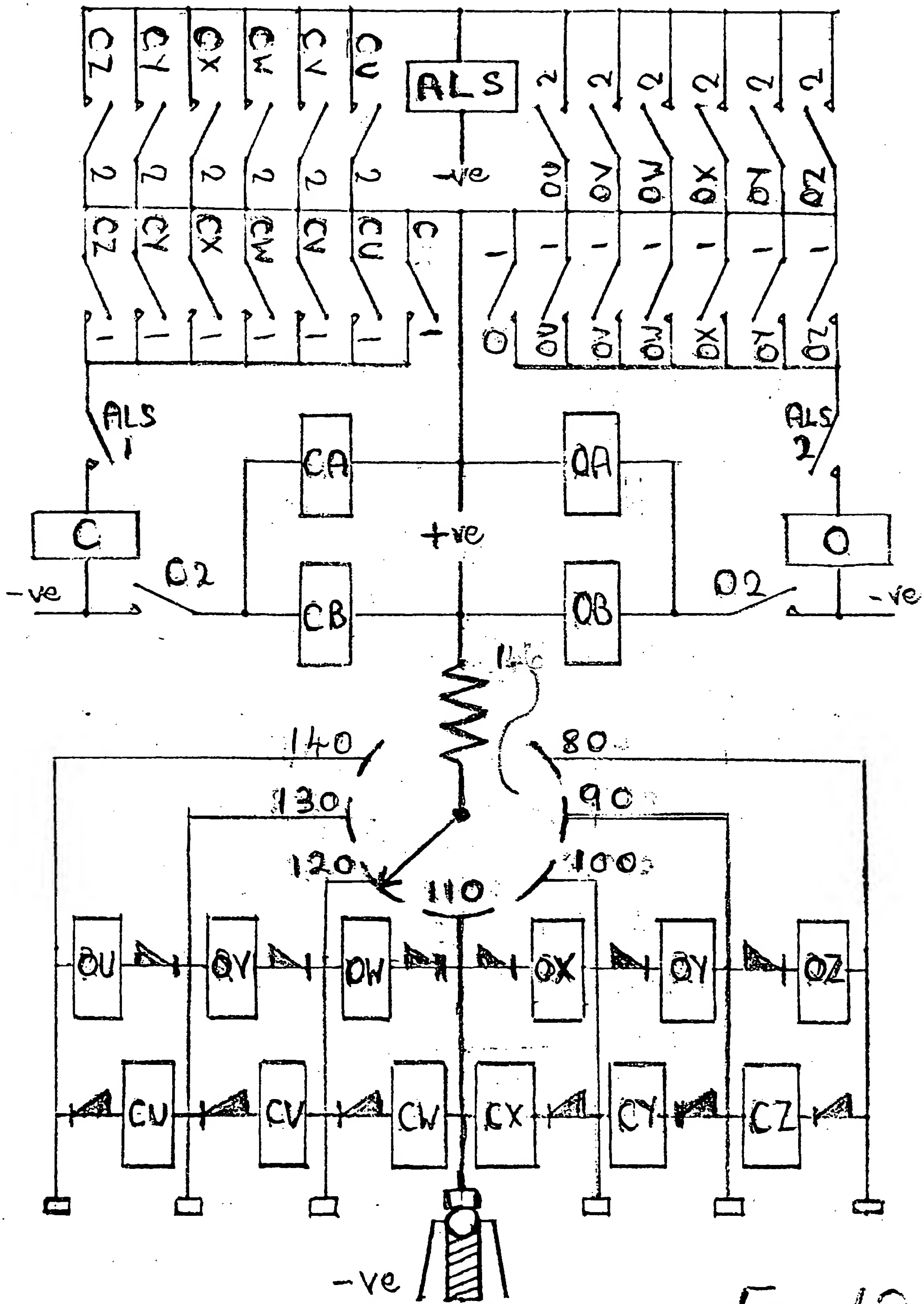
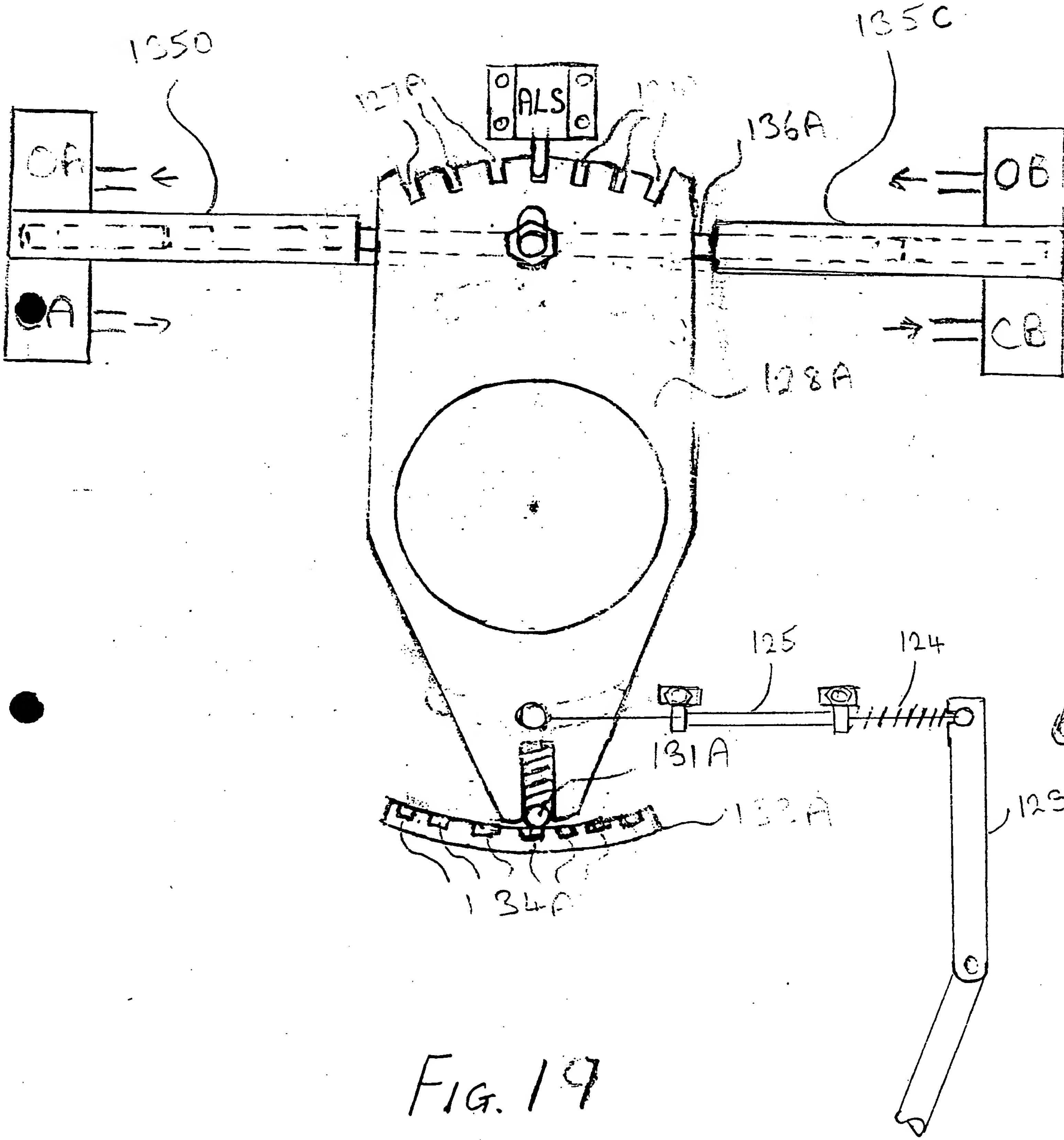

ALS
-ve
+ve
CA
QA
CB
QB
C
O
Q2
140
130
120
110
100
90
80
QU
QV
QW
QX
QY
QZ
CU
CV
CW
CX
CY
CZ

FIG. 18



1350
135C
127A
ALS
136A
OA
OB
CA
CB
128A
125
124
131A
132A
123
134A

FIG. 19